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(54) **Antenna of an electromagnetic detection system, and electromagnetic detection system comprising such antenna**

(57) An antenna configuration of an electromagnetic detection system for detecting and/or identifying detection labels, comprising an antenna loop which is at least conductive for alternating current, which antenna configuration further comprises at least two pairs of current supply lines which are conductively connected with the antenna loop, the current supply lines of each pair of current supply lines extending from the antenna loop towards each other.

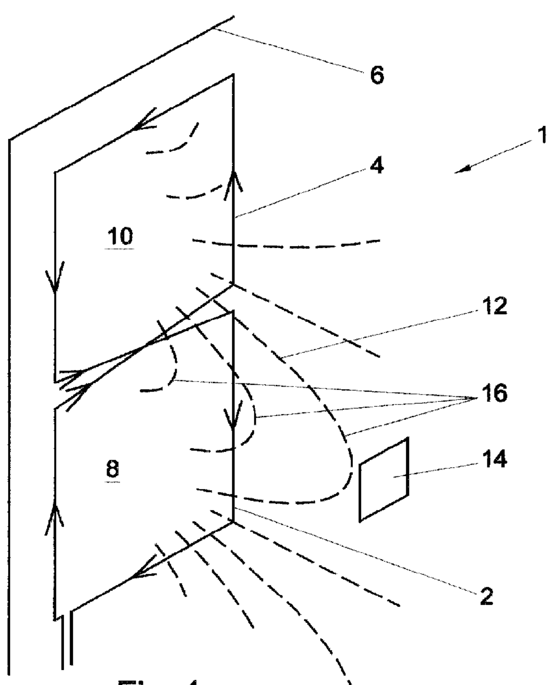

Fig. 1

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Description

[0001] The invention relates to an antenna configuration of an electromagnetic detection system for detecting and/or identifying detection labels, comprising an antenna loop which is at least conductive for alternating current.

[0002] The invention further relates to an electromagnetic detection system for detecting and/or identifying detection labels, comprising a transmitter and/or receiver device and such an antenna configuration.

[0003] Such an antenna in an electromagnetic detection system is known inter alia from European patent application EP 0 645 840.

[0004] The system known from that European patent application is intended in particular as an anti-shoplifting system. Such systems known per se work as follows: the system generates an electromagnetic alternating field by means of an antenna configuration. The frequency of this alternating field can, for instance, be varied over a predetermined frequency interval. A passive detection label comprising a resonance circuit consisting, for instance, of a coil and a capacitance will generate a second electromagnetic alternating field at the moment when a frequency of the field is equal to the resonant frequency of the label, as soon as the label is introduced into the field generated by the antenna configuration. This secondary electromagnetic field can subsequently be received by means of a receiving antenna which is coupled to a receiver of the detection system. In a detection system of the absorption type, this secondary field is received with the same antenna as the antenna with which the primary field has been generated. Accordingly, the antenna configuration can be used not only as receiving antenna but also as a combined transmitting and receiving antenna. Further, the antenna configuration mentioned can be used as a receiving antenna.

[0005] Electromagnetic detection systems which comprise antennas which generate an interrogation field in a predetermined area and which detect a response of a label in the same area are more and more subject to electromagnetic compatibility requirements, EMC requirements for short, which impose limitations on the one hand on the electromagnetic field generated by the (transmitting) antenna at a distance from the detection zone and, on the other, on the susceptibility of the (receiving) antenna to interference from fields of external sources.

[0006] In an attempt to meet these problems, an antenna configuration is used which is provided with a first antenna array comprising an 8-shaped antenna. The coupling of remote fields is then much smaller because the fields of the two halves of the 8-shaped antenna quench each other at a large distance. An 8-shaped antenna which is used as transmitting antenna will therefore generate a negligibly small field at a relatively great distance.

[0007] A disadvantage of the 8-shaped antenna is that in the middle of the antenna the field lines run parallel to the plane of the antenna, so that a detection label oriented parallel to this plane cannot be detected. In an anti-shoplifting system, this phenomenon is sometimes referred to as the trouser pocket effect.

[0008] In Dutch patent application 9201270, this problem is solved in that the antenna configuration is further provided with a second antenna array which comprises an O-shaped antenna, with the first and the second antenna array being respectively driven with transmitting signals that are mutually 90° out of phase.

[0009] A disadvantage of this antenna configuration is that the O-shaped antenna still generates a relatively strong field at a large distance. Such a field can cause interference in an antenna which, for instance, is connected with the receiver of the detection system.

[0010] In European patent application 0 645 840, it is proposed to meet this problem by providing the second antenna array with a plurality of loops. According to the European patent application, the antenna configuration therefore comprises a first and second antenna array which, in use, are connected with a transmitter and/or receiver of the detection system and which are disposed at least substantially in the same plane. The first antenna array and the second antenna array each comprise a plurality of current loops. The advantage of such an antenna configuration is that the electromagnetic fields which are radiated by this antenna configuration will compensate each other at a relatively large distance, so that at this relatively large distance the field will be at least substantially equal to zero. Further, when the first and second antenna array are respectively driven with transmitting signals which are mutually 90° out of phase, non-occurrence of the trouser pocket effect mentioned can be accomplished.

[0011] When the antenna configuration is used as receiving antenna, for instance when the first and/or the second antenna array are used as receiving antenna, the advantage is present that the receiving antenna is unsusceptible to electromagnetic signals radiated at a relatively greater distance. Consequently, the receiver can be made of more sensitive design. A further advantage is that the first and second antenna array at least substantially cannot be inductively coupled. In a large part of the detection zone, the first and second antenna array are therefore independent of each other without being inductively coupled. This provides the possibility of generating a rotary field by driving the first and the second antenna array with transmitting signals which are 90° out of phase. In that case, a field is present in two directions at every point of the detection zone, and the EMC requirements can be satisfied because the radiated electromagnetic fields compensate each other at a large distance, in other words, at a large distance the electromagnetic fields are at least substantially equal to zero. Because at a plurality of points the field lines of the first and the second antenna array are perpendicular

to each other, an optimum rotary field is generated in these points. To achieve this, the second antenna array can preferably comprise more current loops than the first antenna array. In particular, the second antenna array comprises one current loop more than the first antenna array.

[0012] A disadvantage of the antenna configurations which are described in European patent application 0 645 840 is that a large number of the known configurations are not easy to realize practically. It is rather cumbersome to manufacture antenna configurations comprising a first and a second antenna array which each comprise a plurality of loops and which, moreover, are to be arranged in at least substantially the same plane. According to one of the known variants of the European patent application, an antenna array with three current loops is proposed. This antenna array comprises a first antenna loop which, in use, is coupled with the transmitter and/or receiver device, as well as a second antenna loop, closed in itself, the first antenna loop being disposed within the surface enclosed by the second antenna loop. The two loops are not (current-) conductively connected with each other. In the example, the surface enclosed by the second antenna loop is as wide as the surface enclosed by the first antenna loop, but the surface of the second antenna loop is less high than the surface of the first antenna loop. The surface of the second antenna loop is situated approximately in the middle of the surface of the first antenna loop, so that the two antenna loops are electromagnetically coupled with each other. Thus, in effect, a loop antenna with three current loops is formed. Although such an antenna array is easy to manufacture, a disadvantage of this antenna array is the high self-inductance of the driving current loop and the imperfect coupling between the first and the second antenna loop. This makes control from a low-ohmic 50 Ohm source difficult. Now, it is possible to design the circumference of the antenna as a pipe in which the driving second antenna loop is partly contained. Here too, the second antenna loop is not (current-) conductively connected with the circumference of the antenna. Accordingly, it is then screened off except adjacent the cross connections. A further disadvantage of this is that the inherent resonant frequency of this construction is rather low as a result of the parasitic capacitance of the driving wire to the pipe, so that the antenna impedance varies rather strongly over the fairly broad frequency sweep band necessary for a theft detection system.

[0013] The object of the invention is to provide an antenna configuration which can solve in particular the above-mentioned disadvantages of the known antenna configurations according to European patent application 0 645 840. Another object of the invention, however, is to provide antenna configurations with entirely different properties than those described in the European patent application. The invention is therefore not limited to an antenna configuration comprising at least two antenna arrays each comprising a plurality of current loops. The invention also relates to an antenna configuration which, in use, is equivalent to a single antenna array comprising a plurality of current loops. In all cases, however, the antenna configuration according to the invention can be practically realized particularly well.

[0014] To that end, the antenna configuration according to the invention is characterized in that the antenna configuration further comprises at least two pairs of current supply lines which are conductively connected with the antenna loop, while the current supply lines of each pair of current supply lines extend from the antenna loop towards each other.

[0015] On the basis of the antenna loop and the at least two pairs of current supply lines, each of the above-discussed first and second antenna arrays and combinations of the first and second antenna arrays can be realized. The antenna configuration according to the invention is thus rendered highly practicable to realize in that, for instance, the antenna loop can be made of self-supporting construction, for instance on the basis of a metal pipe. It is also possible to manufacture the antenna loop as well as the current supply lines from etched foil or from a die-cut plate. The antenna loop with the current supply lines each extending from the antenna loop towards each other is therefore particularly simple to manufacture.

[0016] In particular, the antenna configuration comprises at least three pairs of current supply lines which are conductively connected with the antenna loop, while the current supply lines of each pair of current supply lines extend from the antenna loop towards each other.

[0017] With such an antenna configuration, an antenna configuration can be realized which, in use, comprises a first and second antenna array, with each antenna array comprising a plurality of current loops.

[0018] In particular, the antenna loop has an elongate shape whose longitudinal direction extends between a first and second end of the antenna loop, the antenna loop comprising a first and second loop part each extending from the first end to the second end and being located opposite each other, a first pair of supply lines being connected with the antenna loop at a first pair of positions, a first and second position of the first pair of positions being respectively located on the first and second loop part, while a second pair of supply lines are connected with the antenna loop at a second pair of positions, a first and second position of the second pair of positions being respectively located on the first and second loop part, and the first pair of positions being situated closer to the first end than are the second pair of positions.

[0019] Such an antenna configuration comprises an antenna array which, in use, can function as the antenna array with three current loops described in the European patent application. To that end, the first and the second loop part can each be driven with transmitting signals which are shifted 180° out of phase relative to each oth-

er.

[0020] According to a more specific embodiment, further, the first pair of positions are located between positions of the antenna loop situated in the middle of the lengths of the first and second loop part, and the first end, while the second pair of positions are located between the positions of the antenna loop situated in the middle of the lengths of the first and second loop part, and the second end.

[0021] In particular, and preferably, the length of the part of the antenna loop that extends along a shortest path between the positions of the first pair of positions is approximately equal to the sum of the lengths of the parts of the antenna loop respectively extending along a shortest path from the positions of the first pair of positions to the positions of the antenna loop located in the middle of the lengths of the first and second loop part.

[0022] Then it also holds, preferably, that the length of the part of the antenna loop that extends along a shortest path between the positions of the second pair of positions is approximately equal to the sum of the lengths of the parts of the antenna loop respectively extending along a shortest path from the positions of the second pair of positions to the positions of the antenna loop located in the middle of the lengths of the first and second loop part.

[0023] In this preferred embodiment, the current loop which is formed by the middle antenna half is equivalent to the current loops which are respectively formed adjacent the first and second end.

[0024] According to a highly advanced embodiment, further, the antenna loop and the first and second pair of supply lines are located at least substantially in a flat plane, while the magnitude of a surface substantially enclosed by the first pair of supply lines and the part of the antenna loop that extends along a shortest path between the positions of the first pair of positions is approximately equal to a surface substantially enclosed by the first pair of supply lines and parts of the antenna loop that respectively extend along a shortest path from the positions of the first pair of positions to the positions of the antenna loop located in the middle of the lengths of the first and second loop part, and the line section interconnecting these latter positions.

[0025] Then it further holds, preferably, that the antenna loop and the first and second pair of supply lines are situated at least substantially in a flat plane, while the magnitude of a surface substantially enclosed by the second pair of supply lines and the part of the antenna loop that extends along a shortest path between the positions of the second pair of positions is approximately equal to a surface substantially enclosed by the second pair of supply lines and parts of the antenna loop that respectively extend along a shortest path from the positions of the second pair of positions to the positions of the antenna loop located in the middle of the lengths of the first and second loop part, and the line section interconnecting these latter positions.

[0026] In that case, it holds for the current loops that bound the first and the second end, that the length of these current loops, as well as the surfaces enclosed by these current loops, is equivalent to the current loop, and the surface enclosed by this current loop, which is located in the middle of the antenna loop.

[0027] In particular, the antenna configuration comprises a third pair of supply lines which are connected with the antenna loop at a third pair of positions, a first and second position of the third pair of positions being respectively located approximately in the middle of the length of the first and second loop part, so that the third pair of supply lines in combination with the antenna loop functionally form an 8-shaped two-loop antenna.

[0028] Thus an antenna configuration has been realized using only one antenna loop which, in use, can be equivalent to a combination of a first antenna array and a second antenna array, the first antenna array comprising two current loops and the second antenna array comprising three current loops, and which antenna arrays are at least substantially disposed in the same plane as is described in the European patent application referred to.

[0029] The invention will presently be further explained with reference to the drawing.

[0030] In the drawing:

Fig. 1 shows a first antenna array with two current loops;

Fig. 2 shows a second antenna array with three current loops;

Fig. 3 shows an assembly comprising the first and second antenna array according to Fig. 1 and Fig. 2;

Fig. 4 shows a possible embodiment of an electromagnetic detection system comprising an antenna configuration according to Fig. 3;

Fig. 5 shows an alternative embodiment of a detection system comprising an antenna configuration according to Fig. 3;

Fig. 6 shows an antenna array which is equivalent to the antenna array according to Fig. 2;

Fig. 7 shows an antenna array which is equivalent to the antenna array according to Fig. 6;

Fig. 8 shows the antenna array according to Fig. 2;

Fig. 9 shows two antenna arrays which are equivalent to the antenna array according to Fig. 8;

Fig. 10 shows a first embodiment of an antenna configuration according to the invention;

Fig. 11 shows a second embodiment of an antenna configuration according to the invention;

Fig. 12 shows a third embodiment of an antenna configuration according to the invention;

Fig. 13 shows a fourth embodiment of an antenna configuration according to the invention; and

Fig. 14 shows a fifth embodiment of an antenna configuration according to the invention.

[0031] On the basis of exemplary embodiments, here-

inafter antenna configurations will be discussed such as they are used in anti-shoplifting systems. It is expressly noted, however, that the invention is not limited thereto.

[0032] The detection zone in anti-shoplifting systems can have dimensions known per se, such as, for instance, 50 cm, 1 m, 2 m, etc. This depends on the dimensions of the antenna configuration. The field which is generated by means of the antenna configuration in the detection zone can be denoted as the near field. The near field, the far field, however, are designations known per se to those skilled in the art, and will therefore not be further explained here. The current loops mentioned hereinafter can be used not only in a transmitting antenna array but also in a combined transmitting and receiving antenna array. It is also conceivable that they are used in a receiving antenna array.

[0033] Electromagnetic detection systems comprise transmitting antennas which generate an interrogation field in a detection area, and receiving antennas for detecting a response from a label located in the detection zone. Such a label can, for instance, comprise a resonant circuit which, for instance, is made up of at least one coil and a capacitance. The detection systems referred to should be compatible with the so-called EMC requirements. These EMC requirements on the one hand impose a limitation on the electromagnetic field that is generated by the transmitting antennas at a larger distance outside the detection zone (the far field). These EMC requirements further impose a limitation on the susceptibility of the receiving antenna to interference from fields of external sources. To meet these problems, often an 8-shaped antenna is used. The coupling with the far field is then much smaller because the fields of the two halves of the 8-shaped antenna quench each other there. Accordingly, an 8-shaped antenna which is used as transmitting antenna will therefore generate a negligibly small electromagnetic field at a remote distance. Moreover, when such an 8-shaped antenna is used as receiving antenna, it is unsusceptible to electromagnetic fields which are generated by a transmitter disposed at a relatively great distance from the antenna. A possible embodiment of an antenna array which comprises an 8-shaped antenna is shown in Fig. 1. The antenna array according to Fig. 1 shows an 8-shaped antenna which comprises a first current loop 2 and a second current loop 4. In this example, the two current loops are disposed in a flat plane 6. The first current loop 2 encloses a first surface 8 and the second current loop 4 encloses a second surface 10. The current loops are wound such that a current through the first current loop flows in a direction opposite to a current in the second current loop. When the antenna array 1 functions as a transmitting antenna, an electromagnetic field 12 is radiated, which is represented in dots in Fig. 1.

[0034] A disadvantage of the antenna array according to Fig. 1 is that in the middle, the field lines run parallel to the antenna plane 6, so that a detection label 14 which is also oriented parallel to this plane 6 cannot be detected.

[0035] The parallel field lines referred to here are designated by reference numeral 16. In anti-shoplifting systems, the above-mentioned effect is sometimes referred to as trouser pocket effect.

[0036] Fig. 2 shows a second antenna array 18, which comprises a rectangle with cross connections at a quarter and three-quarters of the height of the rectangle. The antenna array 18 thus comprises a third current loop 20, a fourth current loop 22, and a fifth current loop 24. The third current loop 20 encloses a third surface 26, the fourth current loop 22 encloses a fourth surface 28, and the fifth current loop 24 encloses a fifth surface 30. The second antenna array 18 is disposed in a flat plane 32. The current loops 20, 22, and 24 are wound such that the rotation direction of the current through the fourth current loop 22 has a direction opposite to the rotation direction of the current through the third current loop 20 and the fifth current loop 24. This implies that an electromagnetic field 34 is generated with two series of positions 36, 38 where the field is parallel to the plane 32. A detection label 40 which is disposed at one of these positions 36 or 38 will again not be detected. Further, the field generated by the fourth current loop 22 will be compensated at a relatively large distance by the electromagnetic field generated by the third current loop 20 and the fifth current loop 24. The electromagnetic fields generated by the second antenna array 18 will therefore compensate each other at a relatively large distance. The far field therefore becomes relatively small.

[0037] In Fig. 3 a possible embodiment of an antenna configuration is shown which provides a solution to the problem of the trouser pocket effect. The antenna configuration according to Fig. 3 is made up of the first antenna array 1 according to Fig. 1 and the second antenna array 18 according to Fig. 2. The planes 6 and 32 coincide at least substantially. It is also possible, however, that a relatively small distance is present between these planes. The antenna configuration according to Fig. 3 has as a property that at spatial positions where the second antenna configuration generates fields that are parallel to the planes 6, 32, the first antenna configuration generates fields that are directed perpendicularly to the planes 6, 32. This means that the two fields in question are directed perpendicularly to each other. In Fig. 3 such positions are designated with reference numeral 40.

[0038] All this means that in a large part of the detection zone the first and second antenna array are independent without being inductively coupled. This provides the possibility of generating a rotary field by driving the two antenna arrays with transmitting signals shifted 90° in phase relative to each other. Then a field in two directions is present at every point of the detection zone. Further, the above-mentioned EMC requirements can be satisfied because the fields balance each other out at a relatively large distance. As is clear from Fig. 3, a detection label that is directed parallel to the plane 6, 32

can be properly detected. A detection label 14' that is directed perpendicularly to the plane 6, 32 is also detected properly. This means that the detection labels can always be detected independently of the direction in which they are oriented. The antenna configuration according to Fig. 3 can therefore be used with advantage in an electromagnetic detection system as shown in Fig. 4. The detection system according to Fig. 4 comprises a transmitter 42 which is coupled with an antenna configuration 44 as shown in Fig. 3. The rotary field which has been discussed in relation to Fig. 3 is generated by means of the transmitter 42. Further, the detection system comprises a receiver 46 and a receiving antenna 48 which is coupled with the receiver. This receiving antenna can be designed, for instance, as an O-shaped antenna. A detection label 14, 14' which is present in the detection field generated with the antenna configuration 44 will radiate a response signal that will be received by the receiver 46 for further processing. According to an alternative embodiment of the electromagnetic detection system, the receiver 46 and the receiving antenna 48 are omitted. The system will then function according to the so-called absorption principle which is well known per se. The transmitter 42 will radiate the rotary field as described hereinbefore. According to this variant, the transmitter further comprises detection means for detecting energy variations in the transmitting signal, which are generated when the detection label 14, 14' responds upon entering the electromagnetic field radiated by the antenna configuration. The antenna configuration according to Fig. 3 can also be used as a transmission system, whereby one of the two antenna arrays is connected with the transmitter 42, while the other one of the two antenna arrays is connected with the receiver 46. All this is schematically indicated in Fig. 5. Because the first antenna array 1 is not inductively coupled to the second antenna array 18, in principle the same sensitivity can be realized as in a transmission system where the receiving and transmitting antennas are arranged in mutual separation.

[0039] In Fig. 5, the transmitter 42 is connected with the first antenna array 1, while the receiver 46 is connected with the second antenna array 18. It is also possible, however, that the transmitter is connected with the second antenna array 18, while the receiver is connected with the first antenna array 1. The electromagnetic detection system according to Fig. 5, however, does not have the possibility of generating a rotary field. On the other hand, the electromagnetic detection system according to Fig. 5 has as an advantage that the amplitude of the generated electromagnetic field outside the detection zone is again relatively small. This is because the fields generated by the current loops of the first antenna array will quench each other at a large distance. On the other hand, the second antenna array 18 which functions as receiving antenna has as an advantage that it is insensitive to signals which have been radiated at a large distance. As a consequence of all this, the entire antenna configuration has a minimal coupling with the surroundings outside the detection zone referred to.

[0040] In Fig. 6 an alternative variant of the second antenna array 18 of Fig. 3 is shown. The second antenna array according to Fig. 6 comprises a first 0-shaped electrical conductor 50 which forms part of the second current loop 22 and encloses the surface 28 of the fourth current loop 22. In use, the free ends of the electromagnetic conductor 50 are connected with the transmitter and/or the receiver. The second antenna array further comprises a second 0-shaped electrical conductor 52, closed in itself, which encompasses a sum of the surfaces 26, 28 and 30 which are enclosed by the third 20, fourth 22 and fifth 24 current loops. The two electrical conductors 50 and 52 are inductively coupled with each other. This means that the electrical conductors 50 and 52 in combination form the current loops 20, 22 and 24. The word "current loop" should therefore be interpreted not in constructional but in functional terms. The properties of the embodiment of the second antenna array 18 such as shown in Fig. 6 are therefore entirely comparable with the antenna array 18 such as it is shown in Fig. 3. The antenna array 18' according to Fig. 6 can therefore replace the antenna array 18 according to Figs. 2, 3, 4 and 5.

[0041] In Fig. 7 an antenna configuration is shown which is equivalent to the antenna configuration according to Fig. 6. Here the electrical conductor 52 is formed by a U-shaped electrical conductor guide tube 70 and a conducting plate 72 connected therewith. The free ends of the U-shaped tube 70 are connected with this conducting base plate 72. The conducting tube 70 is provided with a plurality of openings 74 through which the first electrical conductor 50 passes from within the tube to outside the tube. There where the electrical conductor 50 is contained in the tube 70, a complete inductive coupling is present between the conductor 50 and the tube 70. The conductor 50 and the tube 70, however, are not (current)-conductively connected with each other. For the variant according Fig. 7, therefore, it holds that it can replace the second antenna array as discussed in the applications of Figs. 2, 3, 4, and 5.

[0042] The disadvantage of an antenna configuration with the three current loops according to Fig. 4 is the high self-inductance of the controlling current loop and the imperfect coupling with the conductor along the antenna contour. This makes the control from a low-ohmic 50 Ohm source difficult. Moreover, the inherent resonance frequency of this construction is fairly low as a result of the parasitic capacitance of the control wire to the pipe 70. As a consequence, the antenna impedance may vary rather strongly over the fairly broad frequency sweep necessary for a theft detection system.

[0043] Fig. 8 shows again the second antenna array according to Fig. 2, in which further the circulating currents I are indicated per current loop. The antenna array according to Fig. 8 can also be regarded (see Fig. 9) as two specimens of 8-shaped two-loop antennas 80.1 and

80.2, with the upper antenna 80.1 and the lower antenna 80.2 being driven in opposite phase. This opposite phase is indicated by the symbols + and - in Fig. 9.

[0044] When the two parallel 8-loops 80.1 and 80.2 are driven in parallel, the impedance is four times as low as that of the serial three-loop according to Fig. 8. At equal currents, the field generated by the 8-shaped two-loop antennas 80.1 and 80.2 together is comparable with that of the antenna array according to Fig. 8.

[0045] The antenna loop 22 according to Fig. 8 corresponds to the lower antenna loop 28.1 of the upper two-loop antenna 80.1 and the upper antenna loop 28.2 of the lower 8-shaped two-loop antenna 80.2. The antenna loop 20 of Fig. 8 corresponds with the lower antenna loop 26 of the lower 8-shaped two-loop antenna 80.2, while the antenna loop 24 of Fig. 8 corresponds with the upper antenna loop 24 of the upper 8-shaped two-loop antenna 80.1.

[0046] Now, when the two parallel 8-shaped two-loop antennas 80.1 and 80.2 are moved against each other, the result is comparable with that of the serial three-loop antenna according to Fig. 8. In the array according to Fig. 9, in the middle, two currents run in opposite direction. If the distance of the two conductors 82.1 and 82.2 through which these currents run is reduced to zero, there is no field generated between them anymore, which is what is intended. The resultants of the two currents through the conductors 82.1 and 82.2 is zero when the two central cross conductors 82.1 and 82.2 are connected galvanically with each other. Then no current flows through these conductors anymore and moreover there is no voltage across the conductors anymore. These conductors 82.1 and 82.2 can therefore be omitted without this changing anything. The result is an antenna configuration as shown in Fig. 10. The antenna configuration according to Fig. 10, when driven as discussed in relation to Fig. 9, can therefore generate an electromagnetic field which corresponds with the electromagnetic field that is generated by the antenna configuration according to Fig. 8. The difference, however, is a four times lower impedance in the antenna configuration according to Fig. 10 compared with the antenna configuration according to Fig. 8. Moreover, in Fig. 10, the outer contour is formed by an antenna loop 100 in the form of a closed conductive current-carrying loop 100. In this outer antenna loop 100, therefore, current must be injected at four points, with the current injection, as is indicated in Fig. 10, at the upper end of the antenna configuration being in opposite phase to the current injection at the lower end of the antenna configuration. In the foregoing, it has been demonstrated that in the antenna configuration according to Fig. 10, when it is driven by means of two transmitting signals which are in mutually opposite phase, the same electromagnetic field can be obtained as in the antenna configuration according to Fig. 8 which is driven with one of these transmitting signals. The invention, however, is not in any way limited to such a specific form of drive of the antenna configuration according to Fig. 10. Nor is the invention limited to the specific rectangular form of the antenna configuration.

[0047] More generally, the antenna configuration for an electromagnetic detection system for detecting and/or identifying detection labels according to the invention comprises an antenna loop 100 which is at least conductive for alternating current. The antenna loop 100 can take a rectangular, oval and other shapes. The antenna loop should in any case be conductive for alternating current of the frequency corresponding with the frequency of the electromagnetic field which is to be radiated by the antenna configuration, or the frequency of the electromagnetic signal which is to be received with the antenna configuration according to the invention. The antenna configuration is therefore suitable as transmitting antenna, as receiving antenna, and as a combination thereof. Therefore, the antenna loop may also be interrupted and hence not be conductive for direct current. The interruption may be bridged with a capacitance such that the antenna loop is conductive for the alternating current with said frequency. The antenna configuration according to the invention will hereinafter be indicated by reference numeral 99. The antenna configuration 99 is provided with the antenna loop 100 described hereinabove. The antenna configuration further comprises at least two pairs of current supply lines 102, 104, which are current-conductively connected with the antenna loop 100. The current supply lines 102A, 102B, 104A, 104C of each pair of current supply lines extend from the antenna loop 100 towards each other. In the example of Fig. 10, the current supply lines 102A, 102B, 104A, 104B extend to terminals 106A, 106B, 108A, 108B.

[0048] Accordingly, it holds for each pair of current supply lines that they extend from the antenna loop towards each other. In this example, each pair of current supply lines is disposed in the surface enclosed by the antenna loop 100. In this example, further, it holds that the antenna loop 100 has an elongate shape whose longitudinal direction, which is indicated by arrow L in Fig. 10, extends between a first and second end 110, 112 of the antenna loop 100. The antenna loop 100 comprises a first and second loop part 114, 116 which each extend from the first end 110 to the second end 112 and which are located opposite each other. The first pair of supply lines 102 are current-conductively connected with the antenna loop 100 at first positions 118A, 118B, with a first and second position 118A, 118B of the first pair of positions being respectively located on the first 114 and second 116 loop part. The second pair of supply lines 104 is current-conductively connected with the antenna loop 100 at a second pair of positions 120A, 120B. A first 120A and second 120B position of the second pair of positions 120A, 120B are respectively located on the first 114 and the second 116 loop part. The first pair of positions 118A, 118B are located closer to the first end 110 than are the second pair of positions 120A, 120B.

[0049] More particularly, it holds for the variant according to Fig. 10 that the first pair of positions 118A, 118B are situated between positions 112A, 122B of antenna loop 100 which are located in the middle of the lengths of the first and second loop part, and the first end 110, and that the second pair of positions 120A, 120B are situated between positions 112A, 122B of the antenna loop 100 located in the middle of the lengths of the first and second loop part, and the second end 112.

[0050] When the antenna configuration according to Fig. 10 is driven by means of the above-mentioned two transmitting signals which are in opposite phase, the RF currents which are indicated in Fig. 10 with arrows i will divide again according to the self-inductance ratios. An undesired consequence of the two 8-loops from Fig. 9 being moved against each other is that, as a result, also the self-inductance of the two central transverse sections (the self-inductance of the lines 82.1 and 82.2 of Fig. 9) has decreased to 0 because the resulting current has become 0. In other words, in the middle a piece of path length has disappeared, so that the central antenna half of the surface indicated by reference numeral 124 in Fig. 10 is not equivalent to two half eight loops whose surfaces are indicated in Fig. 9 with reference numerals 124A and 124B. According to a particular variant of the invention, this can be elegantly compensated for by moving the positions 118A and 118B up so far, and moving the positions 120A, 120B down so far, that to all sides equal self-inductances are seen. In Fig. 11 such a particular embodiment of the antenna configuration according to the invention is shown, where parts corresponding to Fig. 10 are provided with the same reference numerals. In the antenna configuration according to Fig. 11, it holds that the loop part indicated by L1A has the same length as the loop part indicated by L2A. It further holds that the loop part indicated by L1B has the same length as the loop part indicated by L2B. It also holds that the length of the loop part indicated by L3A has the same length as the loop part indicated by L4A and that the length of the loop part indicated by L3B has the same length as the loop part indicated by L4B. Accordingly, it holds that the length of parts L1A, L1B of the antenna loop, which respectively extend along a shortest path from the positions 118A, 118B of the first pair of positions to the middle 110M of the first end 110 is approximately equal to the length of the parts L2A, L2B of the antenna loop 100 which respectively extend along a shortest path from the positions 118A, 118B to the positions 122A, 122B of antenna loop 100 located in the middle of the lengths of the first and second loop part 114, 116.

[0051] In this example, the first end 110 consists of a straight line. Therefore the middle of the first end 110 is defined as 110M. In case the antenna loop 100 does not have a rectangular shape but has, for instance, an oval shape, the first end 110 consists of a single point. In this case, the first end 110 coincides with the above-mentioned middle 110M of the first end.

[0052] For the lower half of the antenna configuration according to Fig. 11, an equivalent condition applies. The length of the parts L3A, L3B which respectively extend along a shortest path from the positions 120A, 120B to the middle 112M of the second end 112 is approximately equal to the length of the parts L4A, L4B of the antenna loop 100 respectively extending along a shortest path from the positions 120A, 120B to the positions 122A, 112B of the antenna loop 100 situated in the middle of the lengths of the first and second loop part 114, 116.

[0053] In the example outlined hereinbefore, the antenna is presented as being mirror-symmetrical with respect to arrow L of Fig. 10. If this is not met, L2A can be unequal to L2B, and L1A can be unequal to L1B. More generally, it holds in that case that for the purpose of equal currents the sum of the lengths L1A and L1B is chosen to be equal to the sum of the lengths L2A and L2B. In other words, the length L1A + L1B of a part of the antenna loop extending along a shortest path between the positions 118A, 118B of the first pair of positions is approximately equal to the sum L2A + L2B of the lengths of the parts L2A, L2B of the antenna loop 100 respectively extending along a shortest path from the positions of the first pair of positions 118A, 118B to the positions 122A, 122B situated in the middle of the lengths of the first and second loop part 114, 116. Entirely equivalently, it holds for the lower part of the antenna that the length of the part L3a + L3b of the antenna loop 100 that extends along a shortest path between the positions 120A, 120B of the second pair of positions is approximately equal to the sum L4A + L4B of the lengths of the parts of the antenna loop 100 respectively extending along a shortest path from the positions 120A, 120B of the second pair of positions to the positions 122A, 122B located in the middle of the lengths of the first and second loop part 114, 116.

[0054] According to the particular embodiment of Fig. 11, it has been provided that to all sides equal self-inductances are seen by means of a selection of the above-mentioned lengths L1A, L1B, etc. In the situation according to Fig. 11, to keep the surfaces A1 and A2 equal as well, such as this is the case in Fig. 10, the supply line 101A is placed so as to extend obliquely downwards from the position 118A. If the supply conductor 102A were to extend horizontally from the position 118A, the surface A1 would be much smaller than the surface A2. Presently, it has been provided that the surfaces A1 and A2 are equal to each other again. The angle which the conductor 102A includes with the loop part 114 will depend on the length-width ratio of the antenna loop 100. Given practical ratios, this angle α will be approximately equal to 45 degrees. Entirely equivalently, the supply line 102B also extends obliquely downwards from the position 118B. As a result, the surfaces B1 and B2 are made equal to each other as much as possible. However, if α has a practical value which is equal to 45 degrees, this has as a consequence that the surface A1 is somewhat smaller than the surface A2. All

this would have been different if α had been chosen to be somewhat smaller, as indicated in dots in Fig. 11. For the dotted supply line 102A, it holds that the surface A1 is equal to the surface A2. This follows directly from the fact that the distance indicated by h1 in the figure is equal to the distance indicated by h2 in the figure.

[0055] For the surfaces B1 and B2, something similar applies. Moreover, the same applies to the surfaces C1, C2 and D1, D2 of the lower half of the antenna. All this is also shown in the antenna configuration according to Fig. 12. Again, formulated generally again, it holds that the surface A1 + B1 is preferably at least substantially equal to the surface A2 + B2. It also holds that the surface C1 + D1 is preferably at least substantially equal to the surface C2 + D2. Formulated generally, therefore, it holds that the magnitude of a surface substantially enclosed by the first pair of supply lines 102A, 102B and a part L1A + L1B of the antenna loop 100 that extends along a shortest path between the positions 118A, 118B of the first pair of positions is approximately equal to a surface substantially enclosed by the first pair of supply lines 102A, 102B and parts L2A, L2B of the antenna loop respectively extending along a shortest path from the positions of the first pair of positions 118A, 118B to the positions 122A, 122B of the antenna loop 100 situated in the middle of the lengths of the first and second loop part 114, 116, and the line section 130 that connects these positions 122A, 122B with each other. Likewise, it also holds for the lower half of the antenna that the magnitude of the surface C1+D1 that is substantially enclosed by the second pair of supply lines 104A, 104B and a part L3A + L3B of the antenna loop 100 that extends along a shortest path between the positions 120A, 120B of the second pair of positions is approximately equal to a surface C2 + D2 which is substantially enclosed by the second pair of supply lines 104A, 104B, and parts L4A, L4B of the antenna loop respectively extending along a shortest path from the positions 120A, 120B of the second pair of positions to the positions 122A, 122B of the antenna loop situated in the middle of the lengths of the first and the second loop part, as well as the line section 130.

[0056] In the embodiments outlined hereinbefore, it holds that the antenna loop is of rectangular design, with the first and the second end being formed by the short side of the antenna loop, and with the first and the second loop part being respectively formed by the long side of the antenna loop. As stated, what is involved here is only a variant embodiment and other forms of the antenna loop such as ovals, triangles and the like are possible. In the case of the rectangular antenna loop, it preferably holds, according to the variant of Figs. 11 and 12, that the supply lines 102A, 102B of the first pair of supply lines each extend from the first positions 118A, 118B in the direction of the middle (the line section 130) of the length of the antenna loop (the length in the longitudinal direction) and thereby include the sharp angle α with the parts L2A, L2B of the antenna loop which respectively extend along a shortest path from the positions 118A, 118B of the first pair of positions in the direction of the positions 122A, 122B of the antenna loop situated in the middle of the lengths of the first and the second loop part 114, 116. Similarly, it holds that the supply lines of the second pair each extend from the second positions 120A, 120B in the direction of the middle (the line section 130) of the length of the antenna (in the longitudinal direction) and thereby include a sharp angle β with the parts L4A, L4B of the antenna loop 100, which respectively extend along a shortest path from the positions 120A and 120B of the second pair of positions in the direction of the positions 122A, 122B of the antenna loop situated in the middle of the lengths of the first and the second loop part 114, 116.

[0057] According to the antenna configuration of Fig. 12, it holds in particular that it further comprises a third pair of supply lines 132A, 132B which are connected at a third pair of positions 122A, 122B with the antenna loop, with a first 122A and a second 122B position of a third pair of positions respectively situated approximately in the middle of the length of the first and the second loop part 114, 116, so that the third pair of supply lines in combination with the antenna loop 100 functionally forms an 8-shaped two-loop antenna of a type as discussed in relation with Fig. 1 or of a type as discussed in relation to Fig. 9 for the upper 80.1 or lower 80.2 antenna array discussed. The antenna configuration according to Fig. 12 has the particular property that, in use, it can generate equivalent electromagnetic fields to those discussed in relation to Fig. 3. To that end, a transmitting signal is supplied to the terminals 106A and 106B. This same transmitting signal is supplied to the terminals 108A and 108B in opposite phase. What is thus achieved is that the electromagnetic field is formed such as it has been discussed in relation to Fig. 2. Further, to terminals 134A and 134B of the third pair of supply lines a transmitting signal is supplied that is shifted 90° in phase relative to the transmitting signal that is supplied to the terminals 106A and 106B. The transmitting signal that is supplied to the terminals 134A and 134B then generates a field such as it has been discussed in relation to Fig. 1. In total, therefore, a field is generated that is equivalent to the field that has been discussed in relation to Fig. 3. Thus, with a single antenna loop and three pairs of supply lines, while it holds for each pair that they are (current)conductively connected with the antenna loop, and that these current supply lines of each pair of current supply lines extend from the antenna loop towards each other, an antenna configuration is obtained which generates the same field as the highly complex antenna configuration according to Fig. 3.

[0058] The use of the antenna configuration according to Fig. 12, however, does not, in accordance with the invention, need to be equivalent to that as discussed in relation to Fig. 3. The terminals 106A, 106B, 108A, 108B and 134A, 134B can each be connected with a receiver.

The antenna configuration according to Fig. 12 can be used both in an absorption system and in a transmission system. Further, it is also possible that, for instance, only the terminals 106A, 106B, 108A, 108B are connected with the transmitter as discussed in relation to Fig. 10 and that the terminals 134A, 134B are connected only with a receiver. This yields a detection system as discussed in relation to Fig. 5. It is also possible, however, to use the antenna configuration according to Fig. 12 only as transmitting antenna, with a rotary field being generated such as it has been discussed hereinbefore in relation to inter alia Figs. 2, 10 and 11, while a separate receiving antenna and receiver are used as has been discussed in relation to Fig. 4. For the transmitting antenna, it then holds again that the transmitting signals which are supplied to the first and second pair of supply lines are in mutually opposite phase, while the transmitting signal that is supplied to a third pair of supply lines is shifted 90° in phase relative to the transmitting signal that is supplied to the first or second pair.

[0059] Fig. 13 shows a particular embodiment for generating a rotary field such as discussed in relation to Fig. 12. Here, the first and the second pair of supply lines are respectively connected with the first 137, the second 138 windings of the transformer 36, such that when in use a base RF signal via terminals 139 is supplied to a third winding 140, RF signals that are in mutually opposite phase are supplied to the first and the second pair of supply lines 102 and 104, respectively.

[0060] Functionally, a three-loop antenna has thus been formed, of the type as discussed with reference to Fig. 2, to which the base RF signal referred to is applied. In other words, the first and second pair of supply lines are connected with the first and the second winding of the transformer, such that when in use the base RF signal is applied to the terminals via the transformer an RF signal is supplied to the first pair of supply lines, which generates a first electromagnetic field in the antenna loop, while via the transformer an RF signal is applied to the second pair of supply lines, which generates a second electromagnetic field in the antenna loop, while the first and the second electromagnetic field have the same phase, and the RF signals which in combination are supplied to the first and the second supply lines generate in the antenna loop a third electromagnetic field which is in opposite phase to the first and the second electromagnetic field, so that functionally the three-loop antenna referred to is formed.

[0061] The first and second field in Fig. 2 belong to the surfaces 26 and 30, while the third field in Fig. 2 belongs to the surface 28.

[0062] If the first and second winding of the transformer are connected with the first and second pair of supply lines in the antenna configuration according to Fig. 12, then it appears that across the terminals 106A, 106B and 108A, 108B, respectively, voltages of the 8-loop arise, i.e. voltages of the signals applied to the terminals 134A, 134B. In other words, the 8-loop "sees" the three-loop and they do not properly cancel each other out. Consequently, it is rendered difficult to generate a homogeneous rotary field. A solution to this problem has also been found in the antenna configuration according to Fig. 13. According to Fig. 13, it further holds in particular that the first pair of supply lines extend from the antenna loop towards each other for a part 142A, 142B and proceed to extend for a part 144A, 144B parallel to the longitudinal direction of the antenna loop in the direction of the middle (the line section 130) between the first and the second end 110, 112 of the antenna loop. Similarly, this holds for the second pair. The second pair of supply lines extend from the antenna loop towards each other for a part 146A and 146B and then the second pair of antenna supply lines extend for a part 148A and 148B parallel to the longitudinal direction of the antenna loop in the direction of the middle referred to. The result is that the voltage sources with which the first and the second pair of supply lines are driven presently stand vertically between the driving points. The voltage across the two-loop 8 now "sees" only a little parasitic capacitance in the transformer chosen for his purpose. Across the windings of the transformer there is no voltage of the 8-shaped two-loop antenna because of the vertical symmetry. The reason is that the currents flowing through the parts 144A and 144B are directed opposite to each other, so that these parts in combination do not form an electromagnetic field; accordingly, there is no coupling with the 8-shaped two-loop antenna. The same applies to the parts 148A and 148B. In these parts too, the currents are directed opposite to each other, so that the combination of the two parts 148A and 148B does not form a magnetic field. However, a requirement here is that the parts 144A and 144B are located sufficiently close to each other. The same applies to the parts 148A and 148B. The distance between the parallel parts 144A, 144B and 148A, 148B, respectively, is therefore so chosen, for the RF frequency in question, that the electromagnetic fields generated by the two parts in combination at least substantially cancel each other out.

[0063] Antenna configurations in anti-theft detection systems typically stand on the floor as pillars. Floors generally contain conductors, for instance in the form of reinforcing steel. Consequently, in a perfectly symmetrical antenna, the zero line does not extend horizontally but deviates upwardly according as the distance to the pillar increases. This is unfavorable for the manner in which the remote field strength is determined. The antenna constructions according to the invention provide the possibility of compensating for an upwardly rising zero line by adapting the surface area and self-inductance ratios, for instance by employing different conductor diameters in the antenna constructions.

[0064] In Fig. 14, finally, a possible embodiment of an antenna configuration according to the invention is shown which functionally corresponds with the antenna configuration such as it has been discussed for Fig. 13. Although this does not appear from the drawing, the

supply lines 102, 104, 132 are (current-)conductively connected with the antenna loop 100.

[0065] The invention is not limited in any way to the exemplary embodiments outlined hereinbefore. The antenna configuration can be used both as transmitting antenna, receiving antenna and combinations thereof. Each of the configurations outlined can also be used as receiving antenna. The antenna configuration according to the invention, such as for instance shown in Fig. 14, can therefore be used with advantage in systems as discussed with reference to Figs. 4 and 5. Briefly summarized, the advantages of the embodiments discussed hereinbefore include the following:

- No wires to be pulled into pipes: saves a great deal of assembly time, hence cheaper.
- No problems due to undefined location of wires in pipe, so less spread in capacitive and inductive coupling between the wires mutually and the pipes. Hence also less spread in remote nulling: field strength can be closer to the P.O. limit.
- Central drive: Equal current distribution between upper and lower part, hence better symmetry, more homogeneous rotary field.
- Through improved symmetry and central drive, much less electrical field: hence less sensitive to radio signals and less coupling-in in metal constructions of a building.
- Better nulling with less spread between the two coil systems (2-loop and 3-loop) necessary for a rotary field, in the frame.
- Hence also suitable for a Transmission-Monopillar.
- Parallel-driven loops (both 2-loop and 3-loop) give much lower impedances (4x lower); Less high voltages on the antenna, less hand effect susceptibility, easier to adapt to 50 Ohm with a higher efficiency.
- Higher inherent resonant frequency of the construction, hence flatter course of the impedance over the sweep, so less impedance difference between highest and lowest frequency.
- No damping loop needed for inherent resonances of the frame which are above 20 MHz.
- Less radiation of higher harmonics of the transmitter.
- Suitable for high-Q fixed frequency application, such as 13.56 MHz rotary field identification antenna.
- Unintended currents resulting from asymmetries that would cause additional dipole moments induce a compensation current in the frame which counteracts this effect.

[0066] Finally, it is noted that the antenna loop is preferably manufactured to be self-supporting. It can therefore consist of a solid, in itself closed, loop-shaped electrical conductor. The antenna loop 100 should in any case be conductive for the operating frequency in question. It does not need to be especially conductive for direct current and may therefore be interrupted and may for instance be bridged at the interruption by a capacitance. The antenna loop 100 may also be made up of a solid or hollow U-shaped tube which is connected with a conductive base or foot. It is also possible that the antenna loop and the pairs of supply lines are formed from a die-cut plate or an etched foil. In the case of the etched foil, the antenna configuration may further comprise, for instance, two electrically insulating plates of, for instance, plexiglass, between which the etched foil is included. Such variants are all understood to fall within the scope of the invention.

Claims

1. An antenna configuration of an electromagnetic detection system for detecting and/or identifying detection labels, comprising an antenna loop which is at least conductive for alternating current, **characterized in that** the antenna configuration further comprises at least two pairs of current supply lines which are conductively connected with the antenna loop, while the current supply lines of each pair of current supply lines extend from the antenna loop towards each other.

2. An antenna configuration according to claim 1, **characterized in that** the antenna configuration comprises at least three pairs of current supply lines which are conductively connected with the antenna loop, while the current supply lines of each pair of current supply lines extend from the antenna loop towards each other.

3. An antenna configuration according to claim 1 or 2, **characterized in that** the antenna loop has an elongate shape whose longitudinal direction extends between a first and second end of the antenna loop, the antenna loop comprising a first and second loop part each extending from the first end to the second end and being located opposite each other, a first pair of supply lines being connected with the antenna loop at a first pair of positions, a first and second position of the first pair of positions being respectively located on the first and second loop part, while a second pair of supply lines are connected with the antenna loop at a second pair of positions, a first and second position of the second pair of positions being respectively located on the first and second loop part, and the first pair of positions being situated closer to the first end than are the second pair of positions.

4. An antenna configuration according to claim 3, **characterized in that** the first pair of positions are situated between positions of the antenna loop located in the middle of the lengths of the first and

second loop part, and the first end, while the second pair of positions are situated between the positions of the antenna loop located in the middle of the lengths of the first and second loop part, and the second end.

5. An antenna configuration according to claim 4, **characterized in that** the length of the part of the antenna loop that extends along a shortest path between the positions of the first pair of positions is approximately equal to the sum of the lengths of the parts of the antenna loop which respectively extend along a shortest path from the positions of the first pair of positions to the positions of the antenna loop located in the middle of the lengths of the first and second loop part.

6. An antenna configuration according to claim 4 or 5, **characterized in that** the length of the part of the antenna loop that extends along a shortest path between the positions of the second pair of positions is approximately equal to the sum of the lengths of the parts of the antenna loop that respectively extend along a shortest path from the positions of the second pair of positions to the positions of the antenna loop located in the middle of the lengths of the first and second loop part.

7. An antenna configuration according to any one of claims 4-6, **characterized in that** the antenna loop and the first and second pair of supply lines are located at least substantially in a flat plane, while the magnitude of a surface substantially enclosed by the first pair of supply lines and the part of the antenna loop that extends along a shortest path between the positions of the first pair of positions is approximately equal to a surface substantially enclosed by the first pair of supply lines and parts of the antenna loop that respectively extend along a shortest path from the positions of the first pair of positions to the positions of the antenna loop located in the middle of the lengths of the first and second loop part, and the line section interconnecting these latter positions.

8. An antenna configuration according to any one of claims 4-7, **characterized in that** the antenna loop and the first and second pair of supply lines are situated at least substantially in a flat plane, while the magnitude of a surface substantially enclosed by the second pair of supply lines and the part of the antenna loop that extends along a shortest path between the positions of the second pair of positions is approximately equal to a surface substantially enclosed by the second pair of supply lines and parts of the antenna loop that respectively extend along a shortest path from the positions of the second pair of positions to the positions of the antenna loop located in the middle of the lengths of the first and second loop part, and the line section interconnecting these latter positions.

9. An antenna configuration according to claims 4-8, **characterized in that** the antenna loop is of rectangular design, the first and second end being formed by the short sides of the antenna loop, while the first and second loop part are respectively formed by the long sides of the antenna loop.

10. An antenna configuration according to claim 9, **characterized in that** the supply lines of the first pair each extend from the first positions in the direction of the middle of the length of the antenna loop in the longitudinal direction, while enclosing an acute angle with the parts of the antenna loop which respectively extend along a shortest path from the positions of the first pair of positions in the direction of the positions of the antenna loop located in the middle of the lengths of the first and second loop part.

11. An antenna configuration according to claim 9 or 10, **characterized in that** the supply lines of the second pair each extend from the second positions in the direction of the middle of the length of the antenna loop in the longitudinal direction, while enclosing an acute angle with the parts of the antenna loop which respectively extend along a shortest path from the positions of the second pair of positions in the direction of the positions of the antenna loop located in the middle of the lengths of the first and second loop part.

12. An antenna configuration according to any one of the preceding claims 4-11, **characterized in that** the antenna configuration comprises a third pair of supply lines which are connected with the antenna loop at a third pair of positions, a first and second position of the third pair of positions being respectively located approximately in the middle of the length of the first and second loop part, so that the third pair of supply lines in combination with the antenna loop functionally form an 8-shaped two-loop antenna.

13. An antenna configuration according to any one of the preceding claims 4-12, **characterized in that** the first pair of supply lines extend from the antenna loop towards each other and proceed to extend parallel to the longitudinal direction of the antenna loop in the direction of a middle between the first and second end, while the second pair of supply lines extend from the antenna loop towards each other and proceed to extend parallel to the longitudinal direction of the antenna loop in the direction of the middle between the first and second end.

14. An antenna configuration according to claim 13, **characterized in that** the antenna configuration further comprises a transformer comprising a first and a second winding which are connected with the first and second pair of supply lines and a third pair of windings which is provided with terminals which are arranged to be connected with a transmitter and/or receiver device.

15. An antenna configuration according to claim 14, **characterized in that** the first and second pair of supply lines are respectively connected with the first and second winding of the transformer, such that when in use a base RF signal is supplied to the terminals of the third winding via the transformer RF signals which are in mutually opposite phase are respectively supplied to the first and second pair of supply lines, so that functionally a serial three-loop antenna is formed to which the base RF signal is supplied.

16. An antenna configuration according to claim 14, **characterized in that** the first and second pair of supply lines are connected with the first and second winding of the transformer, such that when in use a base RF signal is supplied to the terminals via the transformer an RF signal is supplied to the first pair of supply lines, which generates a first electromagnetic field in the antenna loop, while via the transformer an RF signal is supplied to the second pair of supply lines, which generates a second electromagnetic field in the antenna loop, the first and the second electromagnetic field having the same phase, while the RF signals which in combination are supplied to the first and second supply lines generate in the antenna loop a third electromagnetic field which is in opposite phase to the first and the second electromagnetic field, so that functionally a serial three-loop antenna is formed.

17. An antenna configuration according to any one of the preceding claims, **characterized in that** the antenna loop provides a self-supporting construction.

18. An antenna configuration according to any one of the preceding claims, **characterized in that** the antenna loop and the pairs of supply lines are formed from a die-cut plate or an etched foil.

19. An antenna configuration according to claim 18, **characterized in that** the antenna configuration comprises two electrically insulating plates of, for instance, plexiglass, between which the etched foil is included.

20. An electromagnetic detection system for detecting and/or identifying detection labels, comprising a transmitter device and an antenna configuration according to claim 12 or according to claim 12 and any one of claims 13-19 which is connected with the transmitter device, the transmitter device being arranged for supplying a first RF signal to the first and second pair of supply lines and for supplying a second RF signal to the third pair of supply lines, with the first and second RF signal being shifted 90° in phase with respect to each other.

21. A detection system according to claim 20, **characterized in that** the system further comprises a receiver device which is connected with the antenna configuration.

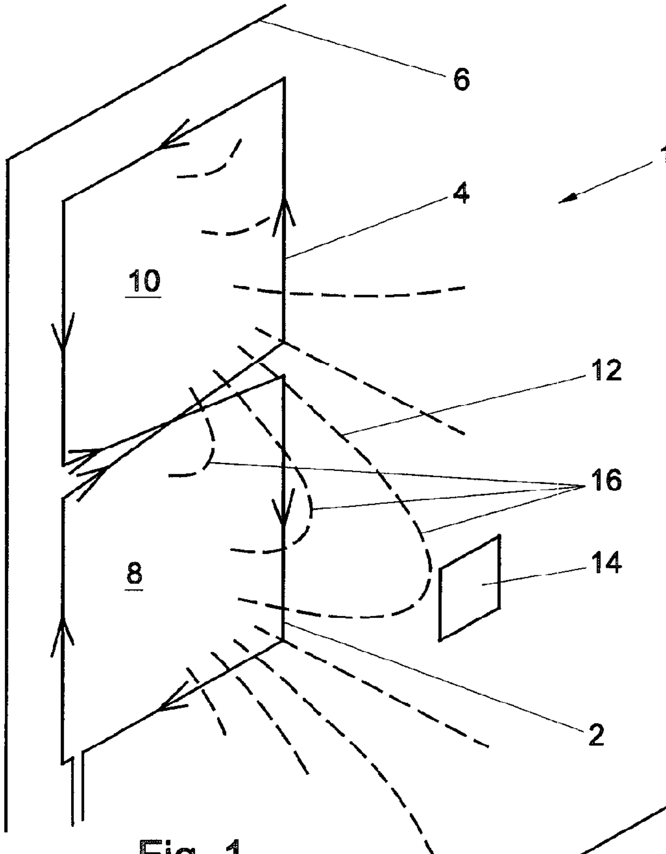

Fig. 1

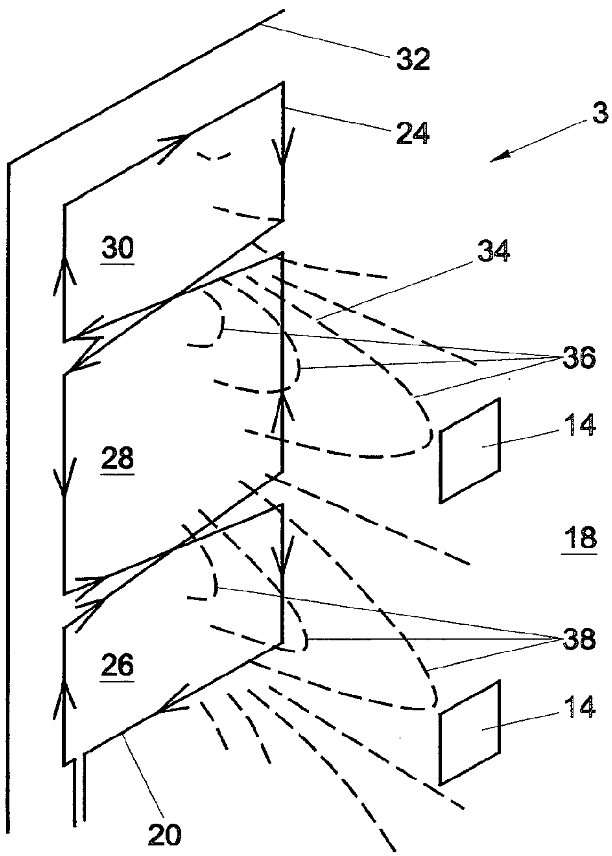

Fig. 2

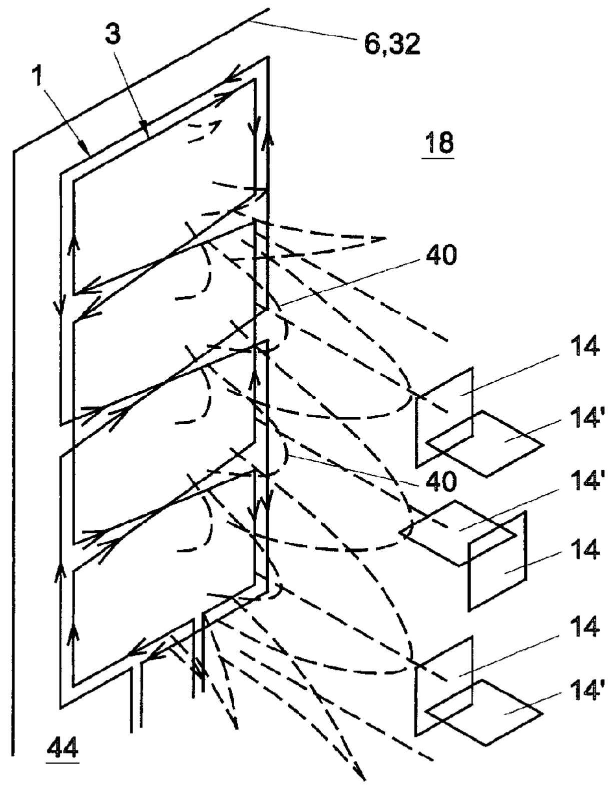

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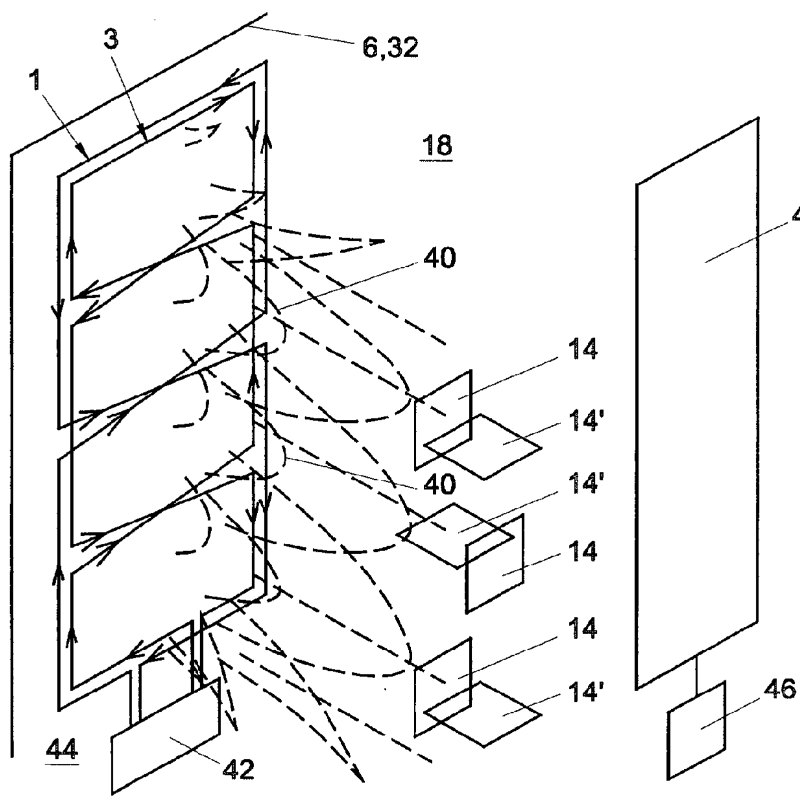
Fig. 3

Fig. 4



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14'
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14
14'
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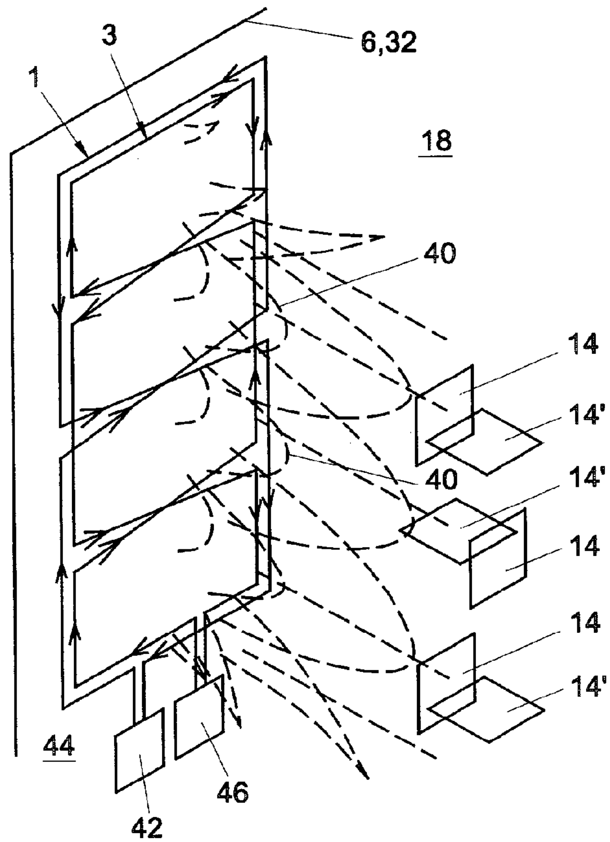

Fig. 5

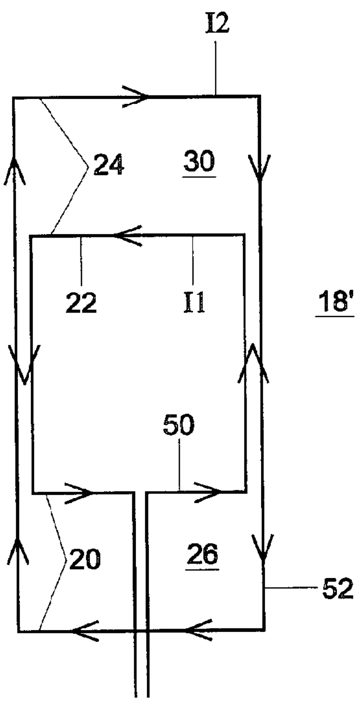

Fig. 6

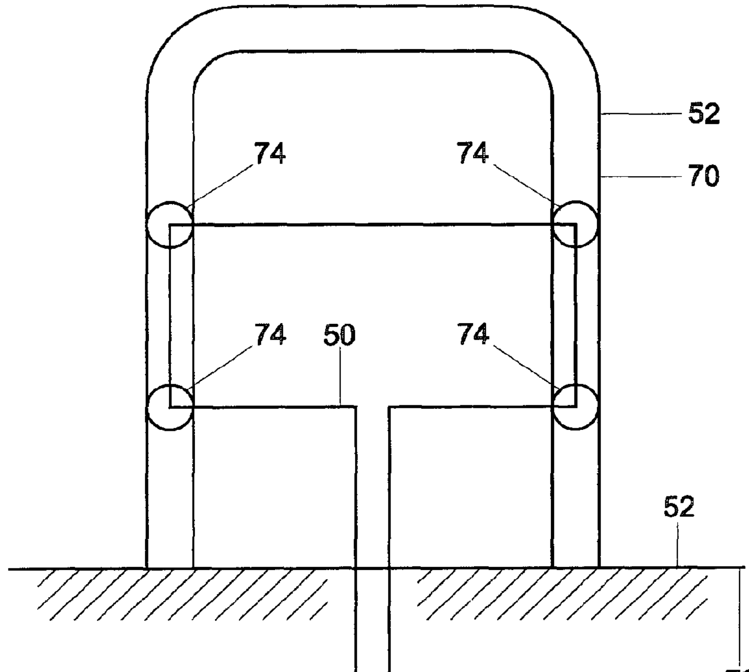

Fig. 7

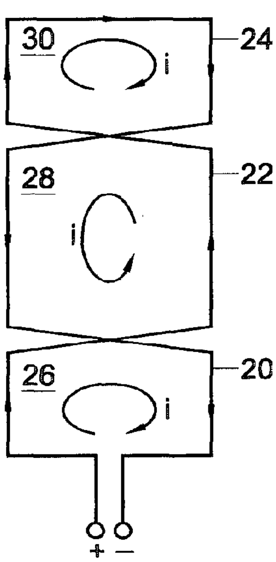

Fig. 8

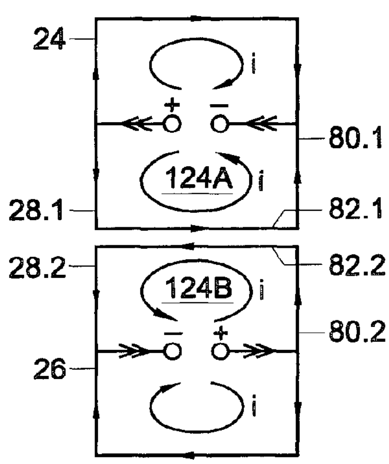

Fig. 9

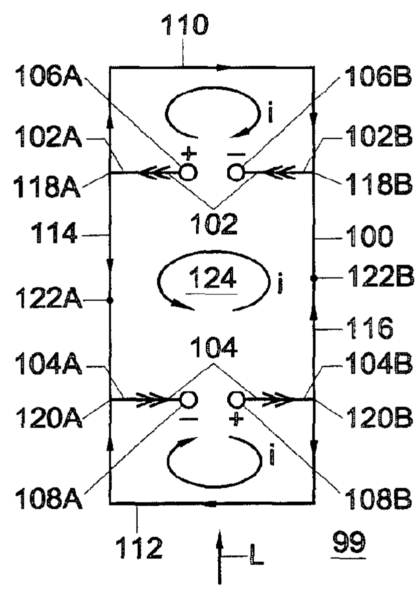

Fig. 10

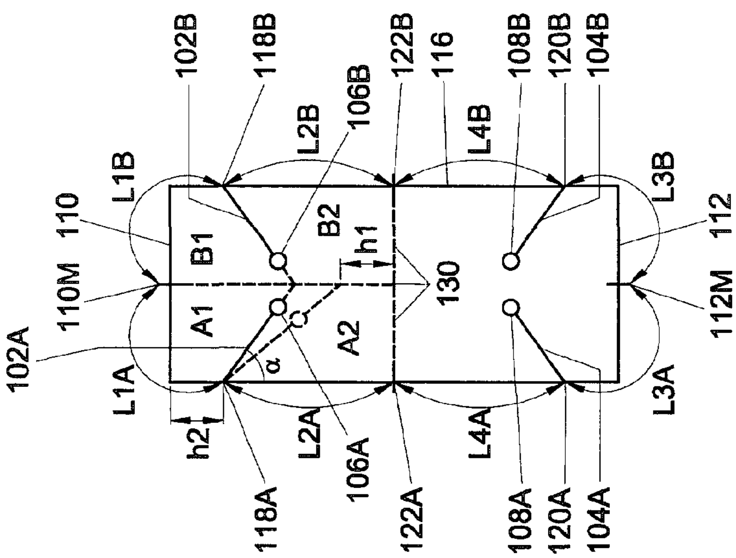

Fig. 11

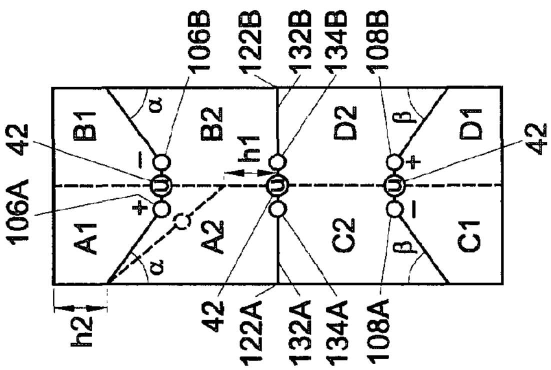

Fig. 12

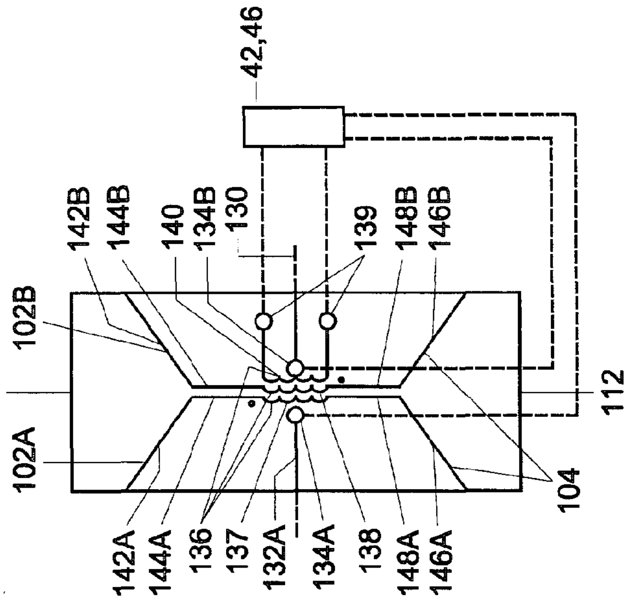

Fig. 13

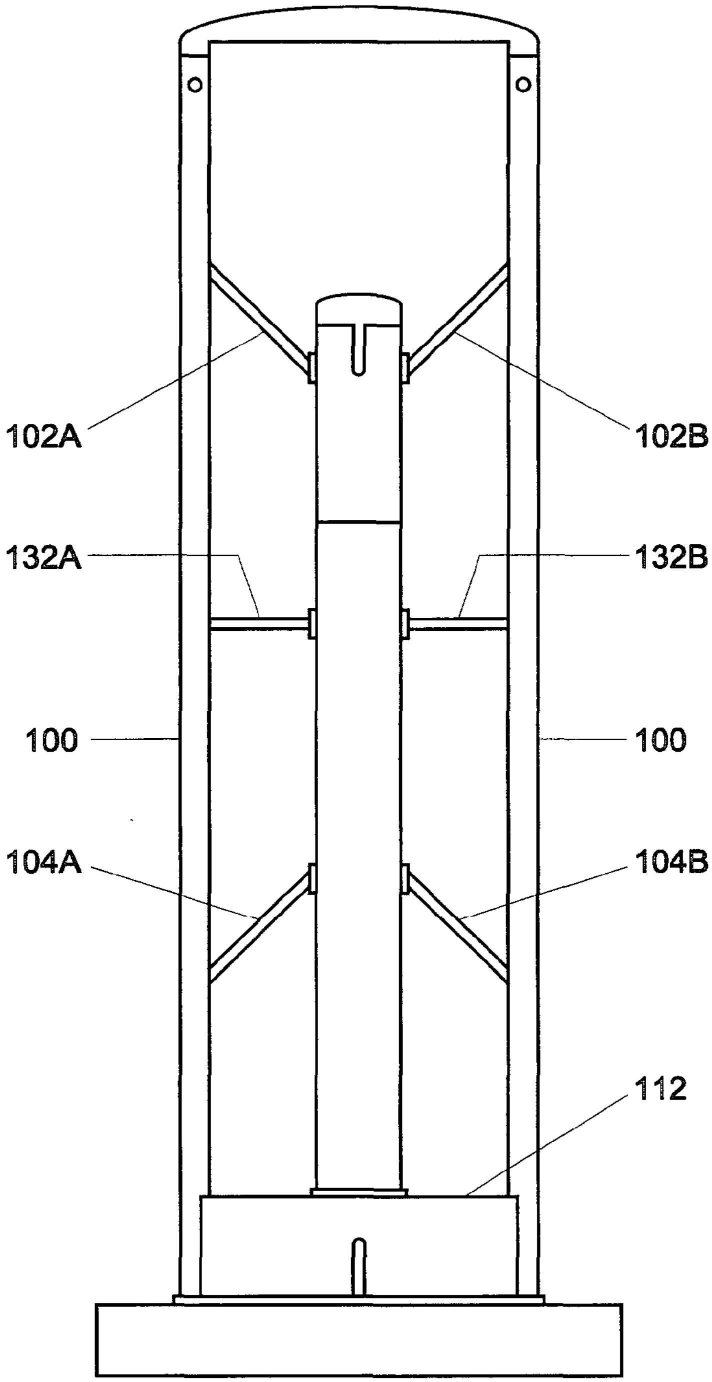

Fig. 14

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Application Number
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Place of search	Date of completion of the search	Examiner
THE HAGUE	17 April 2001	Van Dooren, G

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